

Blockchain, A Developing Technological Revolution: Study of Operational Mechanisms and Future prospects.

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Abstract: We are evolving in a rapidly changing world, characterized by impressive digital transformation and constant technological development. Among the essential technologies driving this transformation is blockchain, which stands out due to its recognition and acceptance by a wide audience. This study aims, through a descriptive and analytical approach, to highlight the importance of this technology and its mechanisms of operation on one hand, and to analyze its future prospects on the other.

Keywords: Digital transformation, Technology, Blockchain, operational Mechanisms, prospects.

Jel Classification Codes : O33 ; L86 ; D85

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1.INTRODUCTION:

Digital transformation involves the deep integration of digital technologies across all sectors of society and business, resulting in fundamental changes in processes and interactions. Blockchain is a key technology in this transformation, marking a significant advancement by enabling secure and transparent transactions without the need for conventional intermediaries. This innovation is closely associated with the concept of a value creation network. It offers a revolutionary approach to validating various types of transactions, whether they involve financial movements, transfers of tangible or intangible goods, or related procedures and approvals. It not only facilitates these transactions but also ensures a level of reliability and security that is nearly impossible to contest or circumvent.

The question of the study:

This study aims to address the following question: How does Blockchain technology work, and what are its future prospects?

Hypothesis:

H1 - Blockchain technology functions as a network where users, each with their own account, are connected to perform various transactions.

H2 - Blockchain is rapidly evolving and has the potential to be integrated into many fields, been adopted by a large number of countries worldwide.

The Objectif of the study:

- Presentation of Blockchain technology;
- Detailed explanation of the mechanisms underlying this technology;

- Analysis of the future perspectives associated with this innovation.

The importance of the study:

The importance of the study stems from the significance of the topic. As we live in a constantly evolving world, marked by the emergence of numerous technologies that have transformed our reality and made it digital, this research focuses on analyzing these new technologies, with particular emphasis on blockchain. This technology has gained significant importance and has been widely accepted by the general public globally, playing a fundamental role in this digital transformation.

Methodology:

We will adopt a descriptive approach to explain blockchain technology and its mechanisms, and an analytical approach to analyze and evaluate its evolution and future prospects through the results of research, studies conducted, and international experiences.

Given the wealth of information on this topic, we will attempt to examine it in three successive parts. We will begin with a thorough exploration of the technology itself, presenting its evolution, different types, and main characteristics. In the second part, we will focus on the principles of how blockchain works and its various application areas. Finally, the third part will be dedicated to examining the future prospects related to this technology

2.What is Blockchain technology (the chain of blocks)?

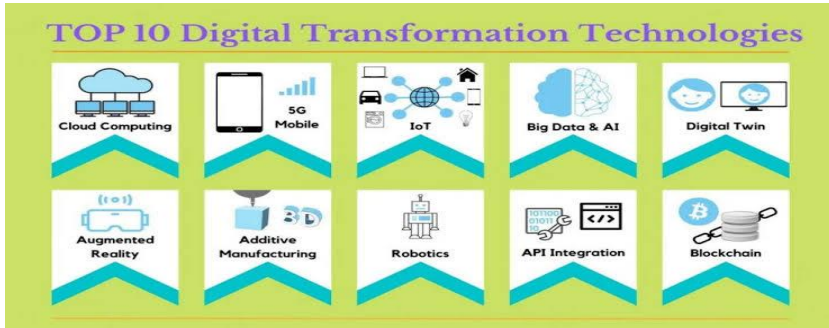
Before presenting blockchain technology, it is essential to understand the concept of *digital transformation*, as blockchain is indeed one of the fundamental technologies of this transformation.

2.1. The Digital Transformation:

Digital transformation is the process that alters the traditional working methods by integrating digital technologies into various aspects of an organization's operations, in order to change or reinvent how it functions (GILLES AUBERGER, 2017). Although it is attracting increasing interest from researchers, there is no uniform definition for this term. Digital transformation is often confused with digitization. Digitization refers to the conversion of physical information or documents into digital formats, such as scanning paper documents into digital format, which allows for immediate access to data from anywhere on any digital device.

In contrast, digital transformation goes beyond this simple conversion. It involves a complete reinvention, encompassing cultural, organizational, and operational changes within a company, industry, or system. This process leverages digital technologies and methods to create new systems, foster a digital mindset, and seize new opportunities.

Figure 01 : The Technologies of Digital Transformation.



Source: Simone Nulli Rinalducci (2024), sustainability-success.com

Digital transformation is essential for today's organizations, and several technologies play a fundamental role in this process, namely: **Cloud Computing**, which enables quick access to software and data, thus promoting great flexibility and agility; and **Mobile Platforms**, which facilitate remote work, thereby increasing productivity.

We also have **Machine Learning** and **Artificial Intelligence (AI)**, which provide precise analytics that enable and facilitate strategic decision-making in various areas at opportune moments. **Robotic Process Automation (RPA)** frees employees from repetitive tasks, allowing them to focus on more important and higher-value missions. Additionally, various **Emerging Technologies** include blockchain, augmented reality (AR), virtual reality (VR), social media, the Internet of Things (IoT), and edge computing, which help businesses innovate and optimize their efficiency.

Digital transformation relies on the integration of these technologies to promote innovation, improve processes, and enhance the competitiveness of organizations.

Indeed, the internet and digital technologies have not only transformed businesses but also redefined how individuals connect, exchange information, and interact with the public and private sectors. They are transforming our world at an incredible pace.

2.2. Definition of blockchain technology:

Blockchain is a series of blocks where various types of information are recorded and linked together to form a long chain. It is defined as a "technology for storing and transmitting information that is transparent, secure, and operates without a central control authority" (PIGNEL, 2019). It is a distributed ledger technology (DLT) that transparently and securely records all transactions in a continuous series of interconnected data blocks. It operates without a central authority and serves as a scalable database, often compared to a public ledger, that maintains a complete history of all exchanges between its users since its inception.

2.3. Creation and Evolution of Blockchain:

The term "*Blockchain*" first appeared in a document titled "Bitcoin: A Peer-to-Peer Electronic Cash System," published in 2008 by an individual or group of individuals using the pseudonym *Satoshi Nakamoto*. The term referred to the fundamental component on which the functioning of the electronic currency system "Bitcoin" relies (ALSUBAEI, 2019).

Blockchain was born alongside Bitcoin, "a cryptocurrency that emerged in 2008 and was created by Satoshi Nakamoto," following the banking crisis of that same year, which undermined trust in financial institutions due to their excessive power and concentration of risks. It was in this climate of distrust that cryptocurrencies emerged (OUSLARI, 2018) Bitcoin allows for the purchase of goods and services and can also be exchanged for other currencies. Unlike traditional currencies, Bitcoin is not regulated by a central banking authority. Today, the term is generally used to refer to all applications and systems based on a distributed transaction ledger.

Today, three main phases or generations in the development of blockchain are distinguished (DMIRTY, 2018):

Blockchain 1.0: "Digital Currency": Blockchain 1.0 represents the first generation of blockchain technology applications, primarily focused on digital currencies like Bitcoin. It includes the underlying technology (mining, hashing, public ledger), the transaction protocol, and the digital currency itself. The main advantages of Bitcoin are: significant reduction in transaction fees for online purchases, increased anonymity compared to credit cards through pseudonymous accounts, and protection against inflation due to a fixed money supply regulated by cryptography, unlike traditional currencies that are regulated by a central bank.

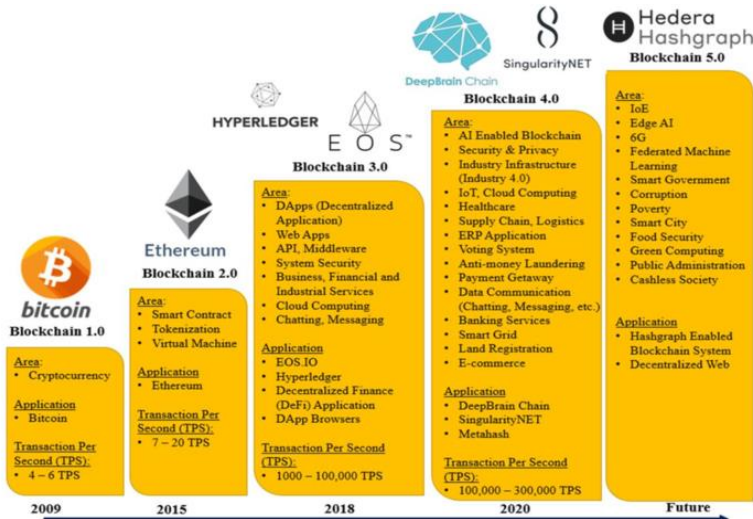
Blockchain 2.0: "Digital Economy": This represents a significant advancement beyond simple financial transactions by introducing a wide range of economic and financial applications. While the concept of the digital economy was proposed over 20 years ago, this generation of blockchain includes traditional financial instruments such as loans and

mortgages, as well as monetizable assets and properties, while enabling innovations like smart contracts. These contracts are computer programs that automatically execute the terms of an agreement, allowing for transparent transactions without paperwork. In 2015, DocuSign[†] introduced a prototype for a smart contract for car rentals without the need to fill out forms. Ethereum is the most well-known platform for these smart contracts, although there are potential security issues that can be detected with developed tools.

Blockchain 3.0: "Digital Society": This phase extends the application of blockchain technology into diverse areas beyond finance, including art, healthcare, and governance. It supports the creation of smart cities, streamlines transactions via the Internet of Things (IoT), and enhances the management of electronic medical records. Furthermore, it provides innovative solutions for handling digital identities and online reputations, ensuring greater security and transparency in these processes.

[†] DocuSign is an electronic signature platform that enables users to securely and legally sign documents online.

Figure N 02: Evolution of Blockchain Technology



Source: Rayhan Kabir; Kamrul ;2022, Evolution of Industry and Blockchain Era: Monitoring Price Hike and Corruption using BIoT for Smart Government and Industry 4.0 p4

Blockchain 4.0: "Today": AI, IoT, and Cloud Computing have made blockchain the central pillar of current Blockchain 4.0 technology. The number of Transactions Per Second (TPS) in this era is significantly higher than in previous blockchain generations (M. KAMRUL, 2022). The next generation, called **Blockchain 5.0**, holds considerable potential with the advent of **6G networks**, encompassing applications such as Smart Cities and Smart Governments. Hashgraph also emerges as a promising technology for **Blockchain 5.0**, as it addresses the limitations of traditional blockchain. The figure above illustrates the evolution of blockchain technology.

2.4. The Characteristics of Blockchain Technology:

Blockchain technology has several key characteristics (PIGNEL, 2019) ,namely:

2.4.1. Decentralization and Disintermediation:

This technology does not require centralization or a third party to oversee the various transactions. The validation and addition of a block result from consensus among the validating users. Traditionally, transaction validation relied on a trusted third party, such as a bank, which ensured that the data (often money) was correctly transferred from person X to person Y, and that person X no longer held the original data.

With blockchain, this trust is now placed exclusively in the technology itself. It allows anyone to verify and validate transactions at any time, without the need for an intermediary.

2.4.2. Transparency and Trust:

When a document is recorded on the blockchain, it is automatically proven to exist at a certain point in time and has not been altered. Additionally, transactions cannot be erased once recorded in the blockchain system, significantly increasing the level of transparency and trust compared to existing transaction systems. This technology is considered transparent because it allows all users to view current and past transactions.

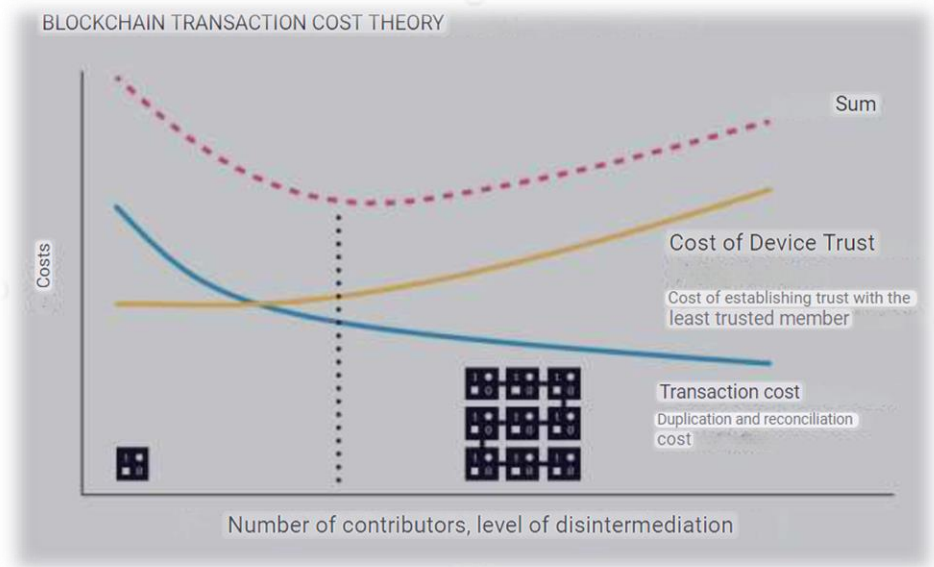
2.4.3. Security

Blockchain offers a high level of security by storing identical blocks of information across its network. Decentralization also contributes to the security of blockchain

by making it nearly impossible to delete all copies of documents, which are stored on numerous servers distributed around the world. Indeed, this technology has strong resistance: all data is duplicated across different servers, protecting it against cyberattacks. The strength of the system also lies in its encryption. There is no entity that approves or rejects the transactions made; it is the involved parties who manage this.

2.4.4. Reducing transaction costs

Blockchain systems help reduce costs by eliminating the need for a third party to carry out transactions, as the transaction ledger is distributed across all devices on the network.



Source : Pierre Gattaz (2016), livre blanc la blockchain pour les entreprises ; p25(Translated by the researcher).

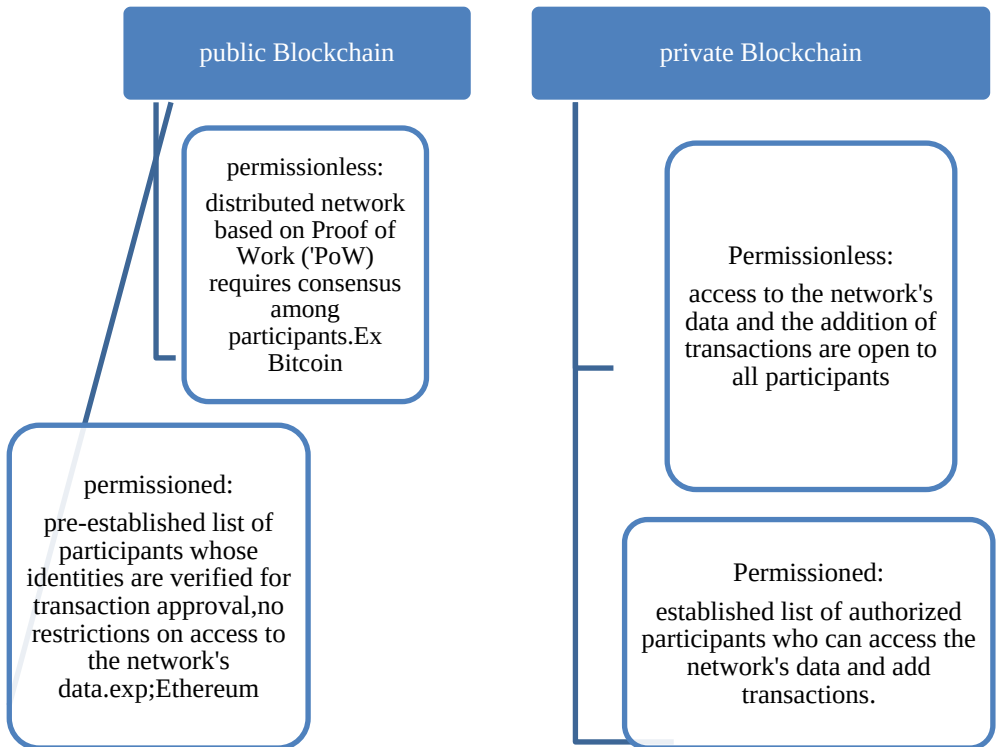
One of the advantages of blockchain is that it helps reduce transaction costs: it secures the database against attacks, eliminates issues of duplication as well as the errors and delays that result from them, and enhances trust within the network.

2.4.5. The speed of transactions:

The execution and validation of transactions only take a few seconds to a few minutes.

2.5. Types of Blockchain Technology :

Currently, there are four categories of blockchain ledgers, organized based on characteristics such as "public or private" and "permissioned or permissionless." They are presented as follows :



Source : Compiled by the researcher based on : Émilie Boily et Myriam Ertz,2019, La technologie de la chaîne de blocs (Blockchain) : catalyseur ou inhibiteur de l'économie collaborative ? p117

For public blockchain, access and use are open to users from the internet. In contrast, private blockchain is reserved for a limited group of users; this type is less decentralized compared to public blockchain.

Indeed, the functioning of blockchain technology is based on the principle of decentralization, combining cryptography, consensus mechanisms, and interconnected block structures

to ensure the integrity, security, and transparency of various transactions.

3.The Operating Mechanisms of Blockchain Technology:

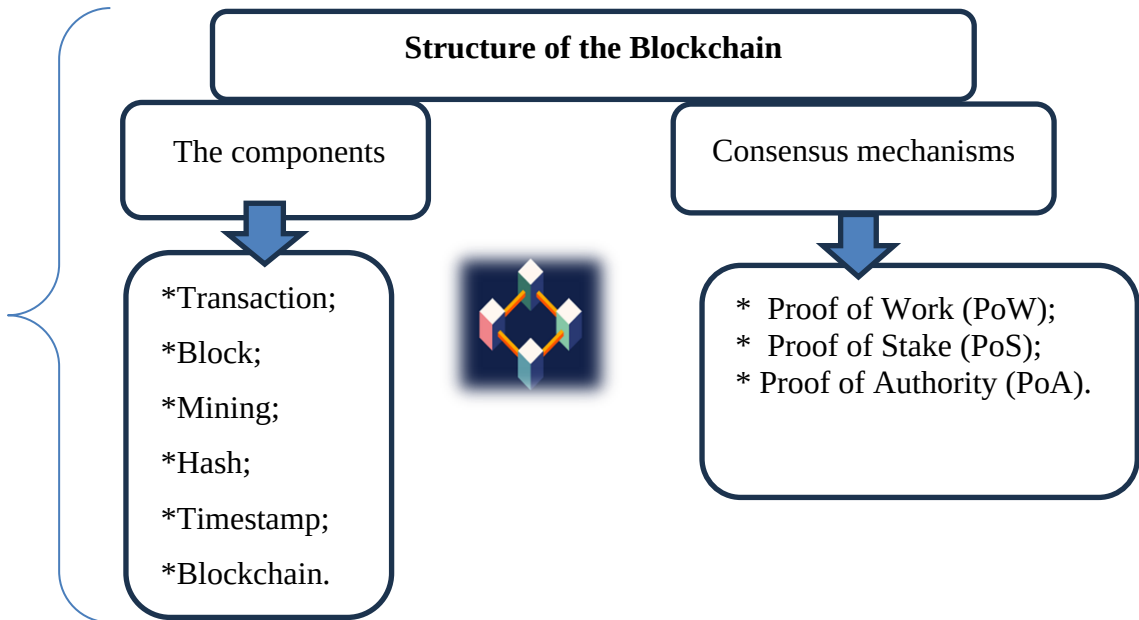
In this section of the article, we will explore in depth how blockchain technology works, drawing on various references such as reports, international studies and research, as well as books and academic articles, including:

- Document by Satoshi Nakamoto: Bitcoin: A Peer-to-Peer Electronic Cash System;
- Blockchain for dummies de John Wiley, 2017
 - Livre Blanc : Institut de gouvernance numérique Registres distribués, l'évolution de la chaîne de blocs, Québec ,2019 ;
 - Report : Blockchain, Banque de France, May 2022 ;
 - Report : Assemblée Nationale, Senat, les enjeux technologiques des blockchain ,2018.

Blockchain technology operates like a vast database where all kinds of information can be recorded, stored, transmitted, and updated. It allows users connected to the network to share this data without the need for intermediaries.

In reality, the execution of a transaction involves the participation of several actors who together form the blockchain. Its architecture is described as decentralized because it is not based on a single server, but rather on a peer-to-peer network where users (considered as both servers and receivers) interact directly with each other.

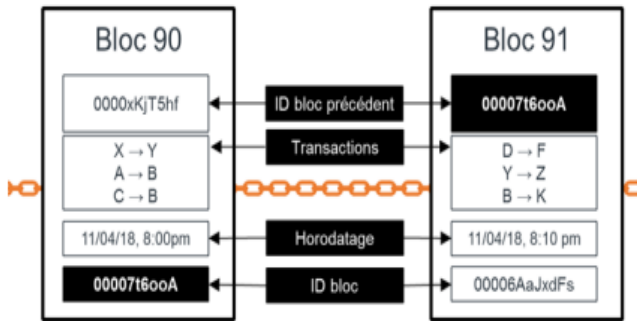
Figure N 03: The Structure of Blockchain Technology.



Source: Compiled by the researcher.

The operation of blockchain technology involves the intervention of the actors presented in the figure above, who ensure the security, integrity, and decentralization of the system according to the consensus protocol. This protocol defines the conditions for actors to enter the chain and the modalities of their participation, ensuring that all participants in the network accept the same data. Transactions between users are grouped into a series of blocks interconnected by a cryptographic process. This relies on a mathematical function called "hashing," which transforms an input data into a unique digital identifier known as a "hash," thereby ensuring the integrity of the data.

Diagram of a Blockchain



Source : Valeria, Claude (2018), les enjeux technologiques des blockchains, Report, NA Senat, 2018, p. 26.

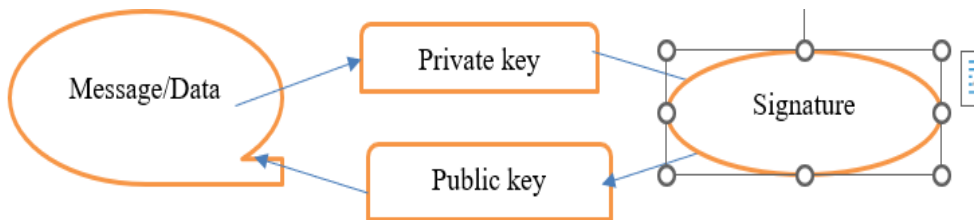
Each block consists of a header that includes information such as the hash of the previous block, a **timestamp** that allows for the verification of the transaction dates, and the **node** (each node represents a user who has an updated copy of the chain) that authored the block, as well as consensus-specific data. It also contains a body that holds the various transactions or recorded data. Each block is linked to the previous block through the **hash**, forming a chain of blocks. Thus, new blocks must be verified and validated by *miners* (validators), who play a crucial role in the blockchain.

Blockchain technology is primarily based on a network structure that is no longer centralized and linear, but rather on a decentralized peer-to-peer network made up of interconnected nodes.

3.1. Cryptography mechanism:

The *Nakamoto protocol* relies on two well-known cryptographic tools: the user's digital signature using their own key and hashing algorithms. These tools, which are one-way functions, allow for the easy computation of values while making their inversion impossible. Although they share certain characteristics, their functioning and applications are distinct. This protocol serves as an essential foundation for the operation of blockchain technology.

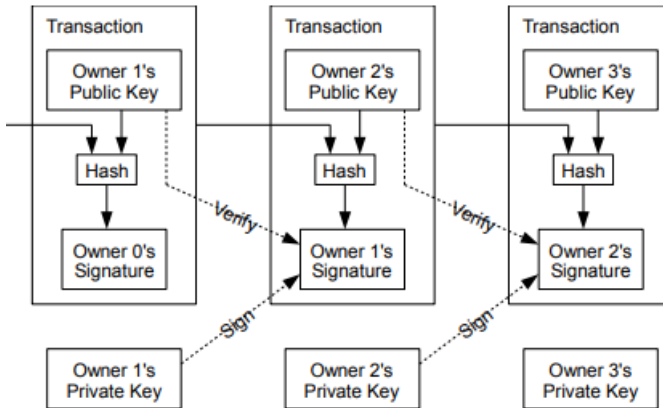
Diagram of the key pair (private/public)



Source: developed by the researcher based on various references

To secure transactions, users of each blockchain apply their digital signature. They use a pair of keys: a private key that allows them to perform transactions, and a public key that enables other users or nodes to verify those transactions. This pair is useful for encrypting or signing a message. This digital signature ensures the immutability of the data and the authenticity of the user.

Diagram of cryptography



Source : Satoshi Nakamoto (2008) document, p. 02

To do this, a user generates a random series of numbers called a private key. Then, an algorithm uses this key to create another key, referred to as a public key.

With this key pair, the user can sign a message with their private key. Other users on the network, who possess the corresponding public key, can then verify its authenticity and confirm that the user is indeed the author of the message.

***Timestamping**

According to the Nakamoto protocol, blocks, composed of several transactions "signed" by public keys, are then "timestamped" by their authors. This timestamping is very important as it allows the blocks to be dated, thereby establishing a chronology where transactions are ordered one after the other. Furthermore, access to the history of the ledger is completely open, meaning that the authors of each block can be located anywhere around the globe.

3.2. Consensus mechanisms:

In a blockchain, consensus is essential to ensure that all users in the network agree on the same data. We can distinguish several common consensus mechanisms presented in the table below:

Protocol	Principles
Proof of Work (PoW)	In the context of major cryptocurrencies, miners must solve complex mathematical problems to validate a transaction and add a new block to the chain, receiving a reward in the process; this is known as mining. Multiple miners work simultaneously to solve this puzzle, and in the case of Bitcoin, the miner who succeeds first receives one bitcoin or a fraction of it as a reward.
Proof of Stake (PoS)	Transaction validation and the addition of new blocks are performed by nodes that can stake tokens. Only users with the largest capital can become validators. Some blockchains have developed algorithms that allow users holding a minimum number of tokens to participate in block validation, thus giving them the opportunity to be rewarded through a lottery system.
Proof of Authority (PoA)	In a consensus system based on Proof of Authority, transactions and blocks are validated by a small number of pre-approved participants (nodes). This model relies on the reputation of these participants who hold these accounts.

Source: Developed by the researcher based on several references

3.3. Process of a transaction on the Blockchain:

Carrying out a transaction on the blockchain requires following several steps and involving different participants.

First, the process begins with the creation of a block, which requires the existence of a transaction, such as a commercial or financial operation, a transfer of cryptocurrency, the buying or selling of digital assets, a modification of a smart contract, or any other operation.

To do this, the blockchain system consists of a network of computers that handles the verification of all information related to the transaction: including the amount, the public addresses of the users involved in the transaction (the "sender" and "recipient"), and any message if the operation requires including a note or message.

Then, once the information is verified and recorded, it will be grouped into a block that is cryptographically linked to the previous blocks ("transaction storage"). This block receives a unique digital identifier known as a "hash" (such as SHA-256 for Bitcoin, for example). Once the block is created, identified, and validated by the nodes in the network, it can be added to the chain. The transaction is then recorded in a block that will not be changed or modified, and it can contain information about an asset, whether tangible (such as a product) or intangible (such as intellectual property).

Additionally, digital assets, such as Bitcoin or other types of assets, are enhanced through a process called "tokenization," which involves recording the rights associated with these assets in the form of digital records. This allows a token to be assigned to an asset, currency, or contract, which can then be exchanged and communicated within the community. Furthermore, the entire history of ownership of that asset is recorded in the blocks. This mechanism enables

tokens to be assigned to these assets based on their quantity, value, and nature.

For the parties involved in the transaction (buyer and seller), the process is also carried out using a cryptographic method based on the key pair (private/public), where the private key is used to sign the executed transactions, and the public key associated with the private key allows for verifying the authenticity and integrity of the transactions. Each party has an address made up of numbers and letters, similar to a bank account identifier, which enables them to perform various operations on the blockchain. To do this, both parties must exchange their respective addresses to complete the transaction.

For the mechanism used: In the context of the blockchain mechanism employing the Proof of Work principle, certain nodes, known as miners, have computing power to verify the received transactions. They then engage in solving a mathematical equation known as a "cryptographic puzzle." The first miner to successfully solve this equation creates the block and transmits it to the community for verification and validation by the majority of network users. In return for their work, this miner receives a reward.

Each node in the network maintains a complete or partial copy of the blockchain. Thanks to this technology, the integration of blocks is chronological, indelible, and tamper-proof.

Thus, the consensus mechanism and the principle of decentralization allow users to ensure the reliability and security of their completed transactions.

In summary, we outline the steps of a transaction conducted on the blockchain by using a simple example: we have two users (Karim and Samir);

Karim wants to transfer 10 units to Samir, knowing that both participants have an address and a key pair (public/private):

1-Samir provides Karim with his address derived from his public key;

2-Karim constructs a transaction containing Samir's address and "signs" it with his own private key;

3-Karim submits the transaction to the network for validation (verification of the signature, transaction checking, and solving the mathematical equation);

4-The first node to successfully solve this equation, the "cryptographic puzzle," adds the block and publishes it to the network;

5-Each node in the network subsequently updates its database by adding the newly created block.

Indeed, this technology allows for the recording, storing, issuing, and transmitting of information, assets, or conducting financial operations in a manner similar to a paper ledger, enabling tracking of all transactions occurring between the various users of the network. It acts like a notary, and each piece of information is verified and validated before being transmitted.

However, according to the *Banque de France* report from May 2022 on blockchain, this technology has some limitations, namely:

- The lack of verification of users' identities on the blockchain and the use of pseudonyms can pose risks such as terrorism financing or money laundering;
- High energy consumption when using this technology, particularly with the Proof of Work mechanism, due to the computing power required for miners to validate transactions;

- Difficulty in modifying or changing information recorded and stored on these distributed ledgers;
- The use of this innovative technology requires a deep and advanced technical understanding, which can hinder its development and adoption by the general public.

4.The future prospects of blockchain technology:

In recent years, many countries around the world have experienced significant technological advancements, adopting various modern technologies. Among the technologies that a large number of countries have recognized as important and have begun to integrate into various sectors and fields is blockchain, a revolutionary technology present in multiple sectors and domains.

Several research studies and surveys conducted on the future of blockchain have highlighted its significant advantages and potential as a major source of innovation. In this section of the article, we analyze the prospects of this technology based on the results of these research studies, as well as testimonials from the general public around the world.

4.1. Applications of blockchain technology:

This technology was initially developed for **cryptocurrencies**, considered a major innovation that gave rise to *Bitcoin*. However, today its scope has become broader, and it has the potential to transform several sectors of the economy. Among these, some areas of blockchain application include :

Smart contracts	One of the important applications of blockchain is
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	smart contracts. This type of agreement, recorded on the blockchain, can be established between two parties using the network, whether in a peer-to-peer (P2P), person-to-organization (P2O), or person-to-machine (P2M) manner.
Financial applications	Distributed ledger technology is already being used in many financial areas, such as payment settlement and various financial transactions.
Public services	It helps to strengthen the management of public services by securing data, improving confidentiality, and automating certain operations. For example: securing the registration of legal documents, certifying contracts, and administering taxes.
Online voting	Current electronic voting systems are often centralized, managed by a single entity, which undermines trust in the process. In contrast, with blockchain being a decentralized, open, and peer-to-peer network, it could overcome these issues and enable electronic voting that voters would trust more.
Health	Blockchain could provide an effective solution for managing sensitive information, such as patient records and medical data control, while ensuring the security and confidentiality of patient information.
Education	This technology could help overcome issues of vulnerability, security, and confidentiality in the archiving of educational records and the awarding of diplomas and certificates.
Commercial and industrial applications.	Blockchain has the potential to become a significant source of innovation for businesses by refining, streamlining, and automating various operational processes.
Insurance	It allows for the automation of reimbursement procedures.
Real estate	To record the transactions made.
The art market	Use of blockchain technology through non-fungible tokens

Source: Developed by the researcher based on (Deloitte reports, 2017; Banque de France, 2022; Patrice Servant, 2019; Adeline Cherqui, 2023).

Blockchain technology represents a significant advancement that enhances many operations across various fields. Although it is still relatively new, having only been around for about a decade, its importance is recognized by several countries around the world.

4.2. Blockchain technology in the world:

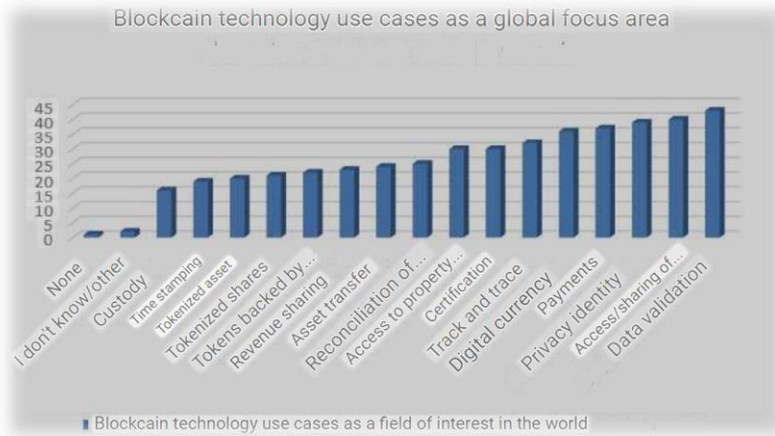
According to the results of a survey conducted by the World Economic Forum (2015), around 800 leaders and experts interviewed by the forum estimated that 10% of the world's gross domestic product (GDP) will be recorded on blockchain technology by 2027. They also confirmed that Bitcoin and digital currencies rely on a distributed trust mechanism known as "blockchain," which facilitates the tracking of transactions in a decentralized manner.

On its part, the study conducted by Deloitte in February 2019 on blockchain, involving 1,400 executives across a dozen countries, shows that 82% of respondents mentioned that their suppliers/customers and competitors were discussing solutions using distributed ledgers (blockchain) to address various challenges within the value chains or were in the process of developing these solutions.

Furthermore, 77% of respondents confirmed the importance of this technology, stating that they risk losing their competitive advantage if they do not implement distributed ledger technology.

Another segment of respondents, specifically 56%, believe that distributed ledgers will lead to disruptions in their industry.

On the other hand, respondents expressed interest in various use cases for blockchain, extending beyond payments and transactions. Here are the blockchain use cases that their organization or project is currently working on.



Source: Developed by the researcher based on the results of the Deloitte study, 2019

The results of the survey conducted by Deloitte in 2019 show a growing interest among companies in various applications of blockchain beyond simple payments. We note that the total percentage exceeds 100% because respondents were allowed to submit multiple answers.

Respondents show strong interest in this technology for data validation (43%) and data access/sharing (40%), highlighting its importance for data integrity and collaboration among stakeholders.

Additionally, 39% of respondents emphasized the importance of identity protection, highlighting the crucial role of this technology in securing personal information. Respondents also believe that this technology plays a vital role in improving supply chain transparency, particularly in tracking and traceability (32%).

Conversely, respondents view payments (37%) and digital currency (36%) as lower priorities compared to other applications in the financial sector.

also, regarding tokenization, respondents indicate that companies are seeking to innovate their business models, focusing on tokenized assets (21%) and tokenized shares (22%).

This technology is under development, with several studies and surveys confirming that global investments in blockchain solutions are expected to see significant growth in the coming years.

According to the Digital Governance Institute of Quebec, in its white paper and "govchain.com," various countries that have adopted or are testing this technology are classified as follows:

Level 01: Has applied blockchain to various use cases and is likely to become a thriving economy: Australia, European Union, Sweden, Singapore, Gibraltar, Indonesia, Nigeria, South Africa, Bahrain, Estonia, United Arab Emirates, United Kingdom, and the United States.

Level 02: Has taken steps to encourage innovation, but the work remains preliminary: France, Dominican Republic, Haiti, Ghana, Illinois/Colorado, OECD, Financial Action Task Force, Isle of Man, Kenya, Thailand.

Level 03: Has adopted a skeptical approach and is currently unwilling to test blockchain-based initiatives: Brazil and China. While GovChain still considers China a skeptical country due to authorities' distrust of Bitcoin, the country is actively developing blockchain technology (SERVANT, 2019), Several sources also indicate that China is about to launch its own cryptocurrency.

4.3. Blockchain in Algeria:

For its part, Algeria is also seeking to promote this new technology by organizing various conferences and studies to encourage its development.

According to Nessim Beelaouer, co-founder of Blockchain Algeria, during a conference in 2017 on “L'apport de la blockchain et de la cryptomonnaie à l'économie numérique en Algérie» (NASSIM BEELAOUR, 2017); the country has the potential to develop this technology by launching a 100% Algerian cryptocurrency, "DZCoin," stating that:

- The DZCoin will facilitate the establishment of a payment method suited to Algeria's digital economy;
- It will be based on blockchain technology and advanced solutions designed to meet the needs of participants in the Algerian market: individuals, businesses, and investors;
- National cryptocurrency linked to the Algerian dinar;
- Private/consortium blockchain supervised by Algerian public institutions;
- Operations on a "Lightning Network" with an energy-efficient Proof-of-Stake (PoS) system, optimized for microtransactions.

Furthermore, blockchain is being developed in many countries, particularly in Arab nations. Several indicators have confirmed that these countries are making significant efforts in technology, innovation, and digital transformation.

According to the Arab Digital Economy Index 2024 (Arab Federation Digital Economy.org), (<https://arab-digital-economy.org>, dubai, 2024), Gulf countries, particularly the United Arab Emirates, are leading in digital growth despite global challenge.

The second category includes Jordan, Morocco, Tunisia, Egypt, Algeria, and Lebanon, which demonstrate a willingness to enhance their technological capabilities and digital infrastructure.

The third category includes Iraq, Syria, Djibouti, Mauritania, Sudan, Libya, Comoros, Somalia, Yemen, and Palestine. This category is characterized by countries seeking development, working to overcome challenges to integrate into the global digital economy.

5.conclusion:

Blockchain technology is a revolutionary innovation that enhances various processes across multiple sectors. Although it is relatively young, having been developed only about a decade ago, its importance is recognized by many countries around the world. It offers numerous features and advantages, such as decentralization, trust, transparency, and security, which encourage the general public to adopt it. It is also based on the principle of consensus and utilizes addresses, accounts, and cryptographic keys, validating our first hypothesis. Furthermore, its acceptance by numerous countries worldwide attests to its significance and potential to become an innovative and essential technology in digital transformation, thus confirming our second hypothesis. Finally, we recommend further developing this technology, strengthening it with appropriate regulations, and encouraging other countries to adopt it.

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